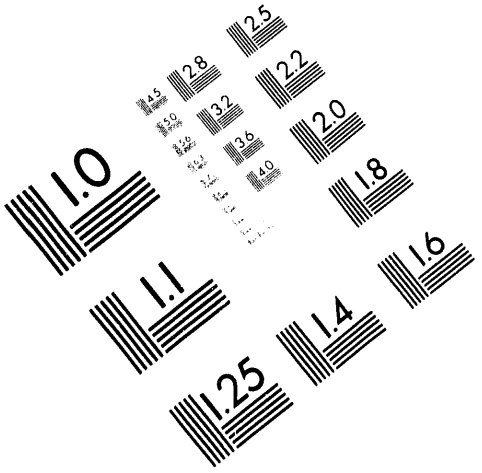

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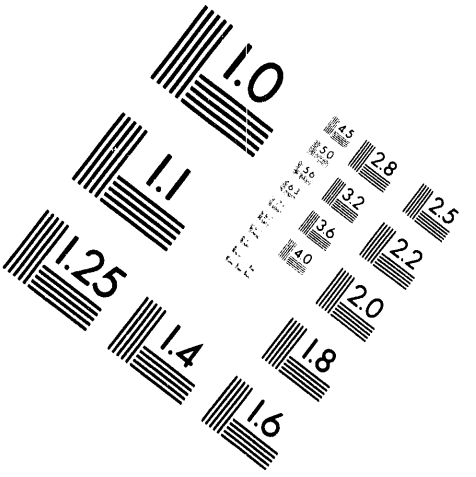

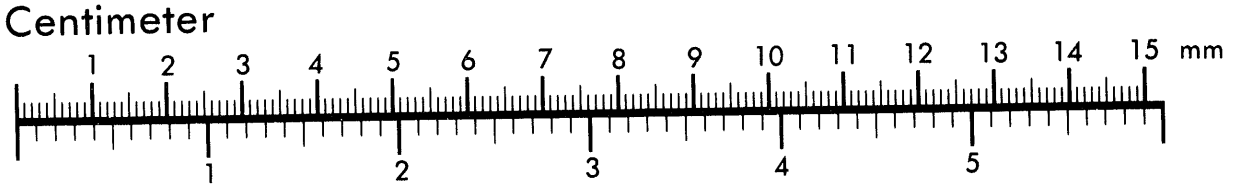

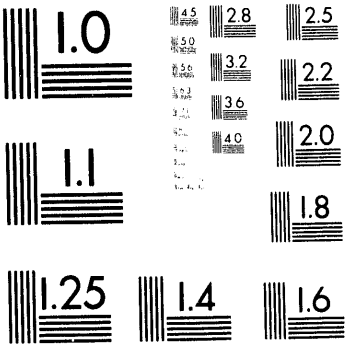

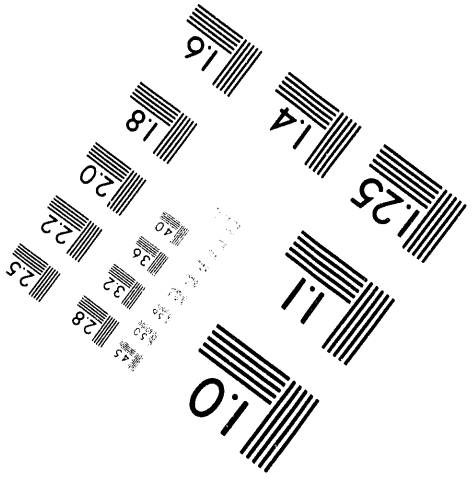

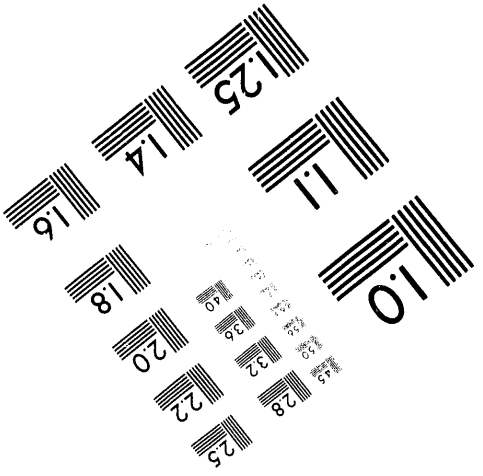

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METASTABILITY OF ALPHA PLUTONIUM

R. D. NELSON

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METASTABILITY OF ALPHA PLUTONIUM

The metastability of alpha plutonium above the $\alpha \rightleftharpoons \beta$ equilibrium transformation temperature (112 C) was studied by metallographic techniques. The purpose of this study was to extend the previous work on the $\alpha \rightarrow \beta$ transformation which was accomplished using fluid displacement techniques[1] and to obtain a basis for determining the length of time the alpha phase is stable at high temperatures. Approximate isothermal reaction curves were determined experimentally and an $\alpha \rightarrow \beta$ time-temperature-transformation (T-T-T) curve was derived.

Specimens used in this study were machined wafers one centimeter in diameter and one millimeter thick. A moderately coarse grained alpha structure was obtained in these specimens by beta heat treatment 1.5 hours at 170 C, quenching to 80 C, and holding four days to alloy for essential completion of the $\beta \rightarrow \alpha$ transformation.

The coarse grained specimens were quickly immersed in a molten Bi-Sn bath for 0.5 to 15 seconds at 180 C, 280 C, 350 C, 475 C, 550 C, and 650 C. These temperatures each correspond to a point in the beta, gamma, delta, delta-prime, epsilon, and liquid phase regions respectively. The specimens were then rapidly (less than 0.5 second) transferred to a fluorochemical bath at -75 C.

Metallographic examination revealed the relative amounts of alpha which had and had not undergone transformation during heating and cooling of the specimens. The untransformed metal remained as coarse grained alpha, whereas that which had undergone transformation to one of the higher phases was observed as very fine grained alpha. The relative amounts of each was approximated by visual examination. From this determination, isothermal reaction curves were plotted, Figure 1. Using these data and those from the previous work of temperatures low in the beta phase region, a complete T-T-T curve of the decomposition of alpha plutonium was derived, Figure 2.

The alpha phase was stable less than 0.5 second above 200 C. The phases into which the alpha phase transformed was not apparent from this experiment. Obviously, at the high temperatures, one or more of the intermediate phases were bypassed during heating and cooling. The transformation of the alpha phase at these elevated temperatures are shown in Figures 3 - 6.

R. D. Nelson
Physical Metallurgy
METALLURGY RESEARCH OPERATION

RDN:vls

1) Nelson, R. D., Transformation Kinetics of Plutonium, Part III, HW-76059, 1962.

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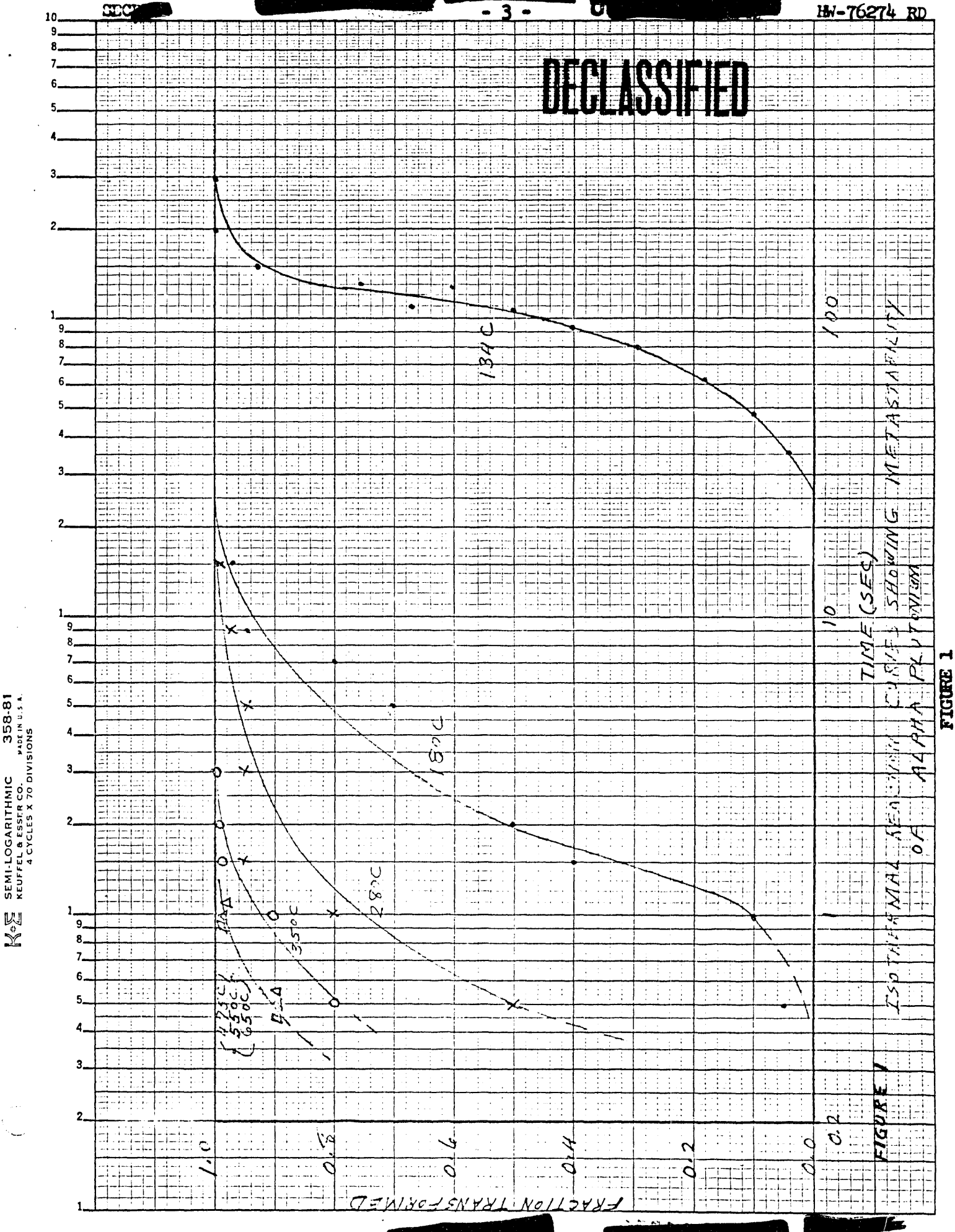

FIGURE 1 ISOTHERMAL SENSITIZATION CURVES SHOWING METASTABILITY OF ALPHA PLUTONIUM

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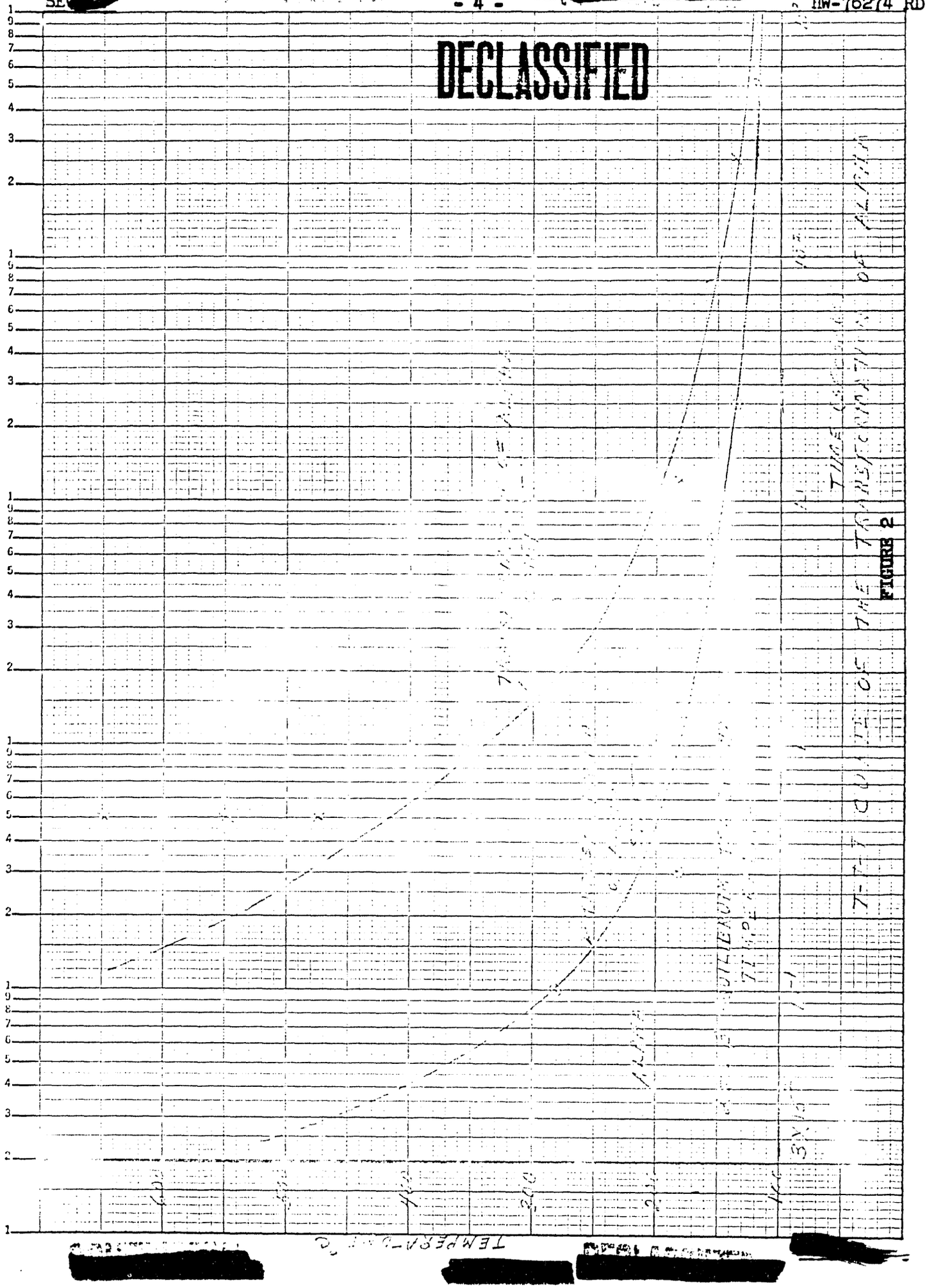
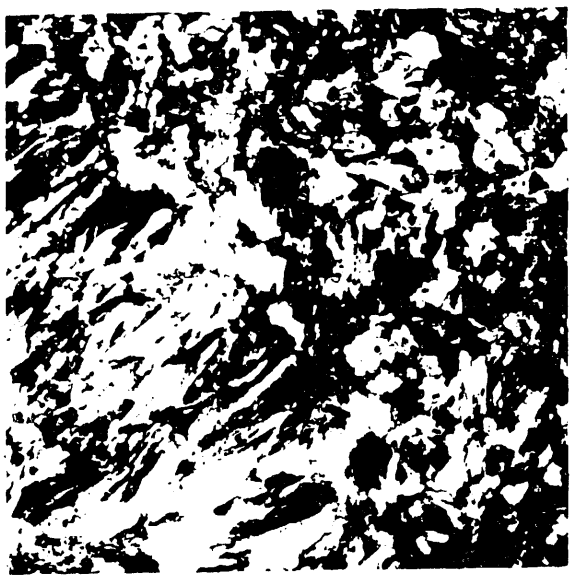
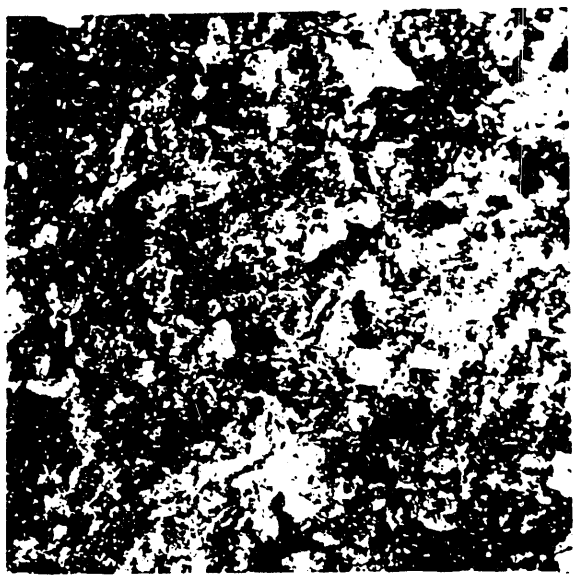


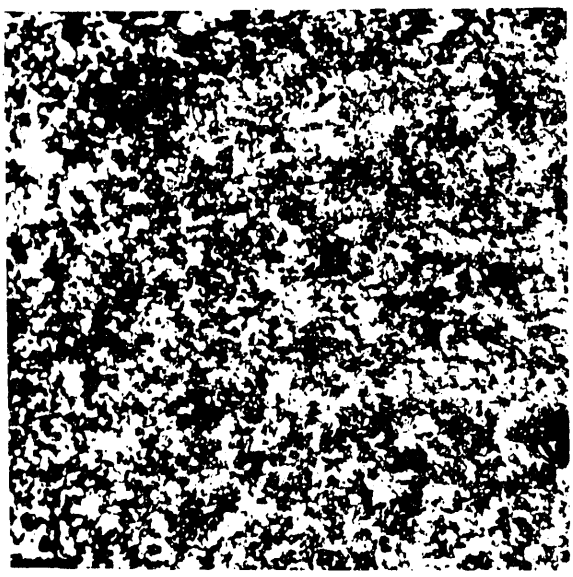
FIGURE 2



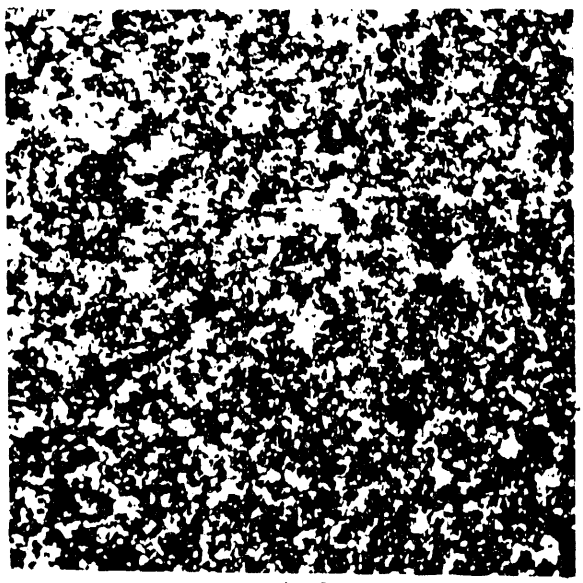
Before Transformation



0.5 second at 650 C



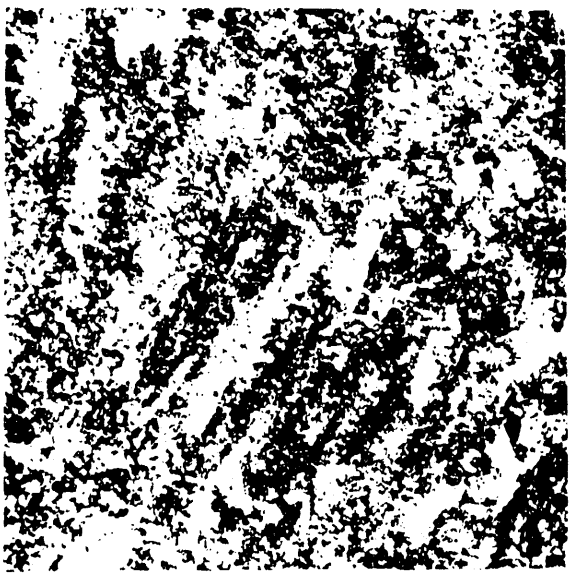
0.5 second at 550 C



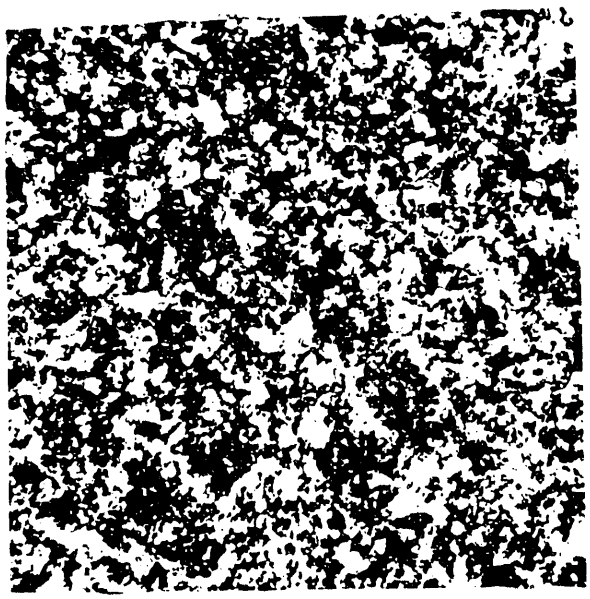
0.5 second at 478 C

FIGURE 3

PHOTOMICROGRAPHS SHOWING THE TRANSFORMATION OF ALPHA PLUTONIUM. 200 X.



0.5 Second



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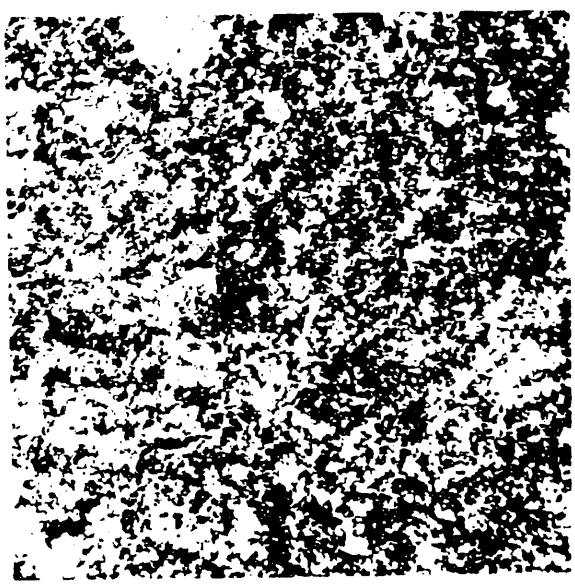

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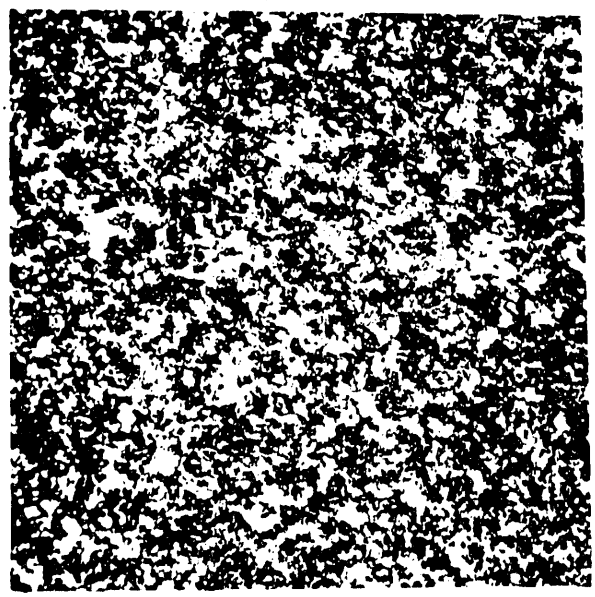
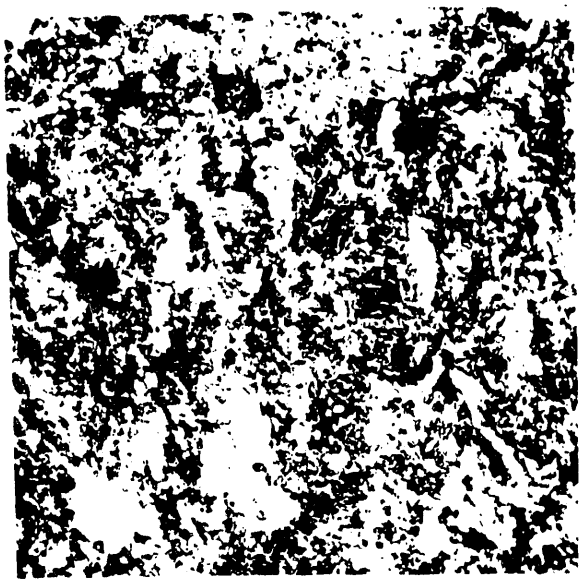


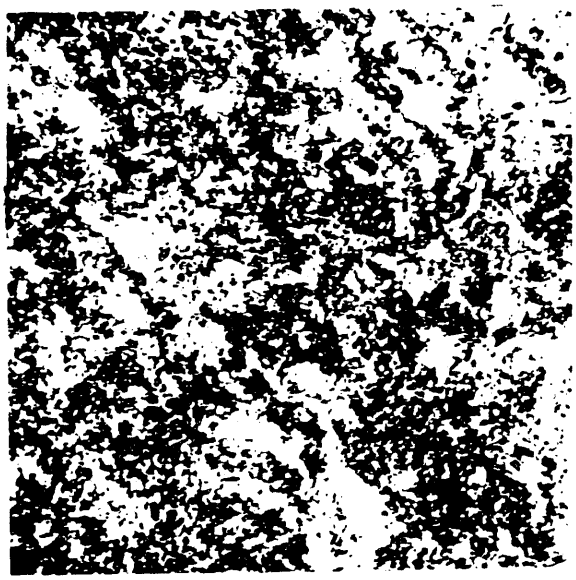
Three Seconds

FIGURE 4

PHOTOMICROGRAPHS SHOWING THE TRANSFORMATION OF ALPHA AT 350 C. 200 X. POLARIZED LIGHT.



0.5 Second



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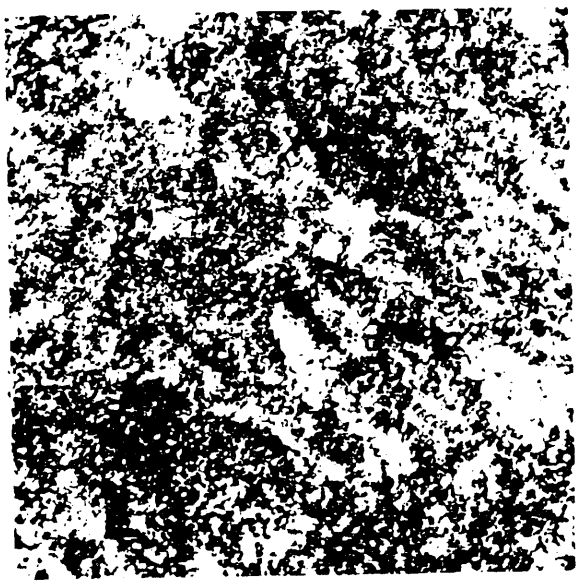

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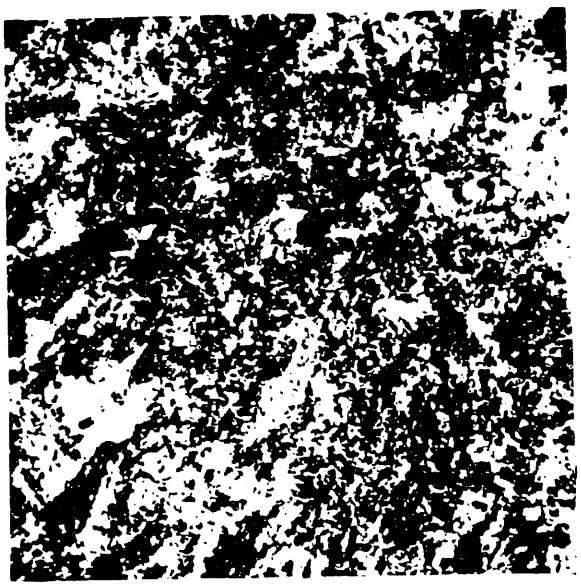
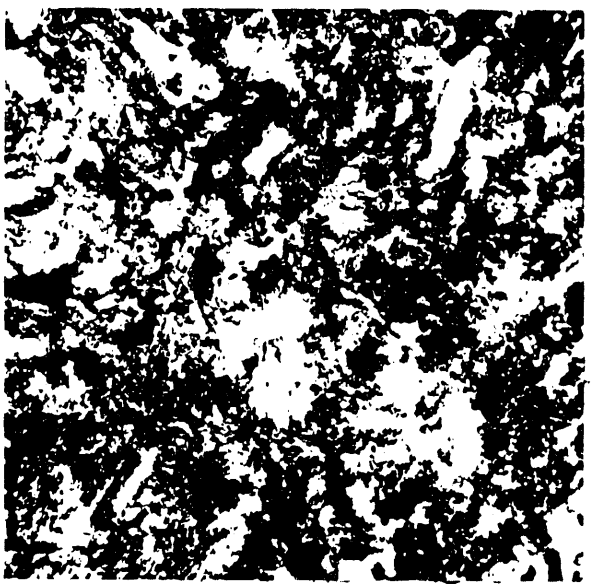


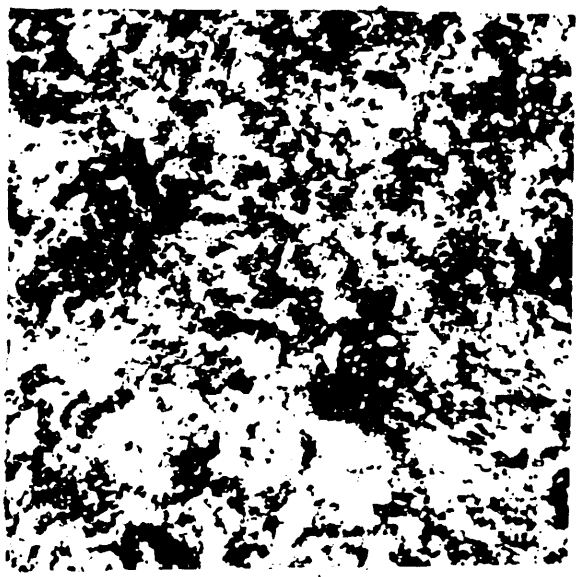
Five Seconds

FIGURE 5

PHOTOMICROGRAPHS SHOWING THE TRANSFORMATION OF ALPHA AT 200 C; 200 X. POLARIZED LIGHT.



One Second



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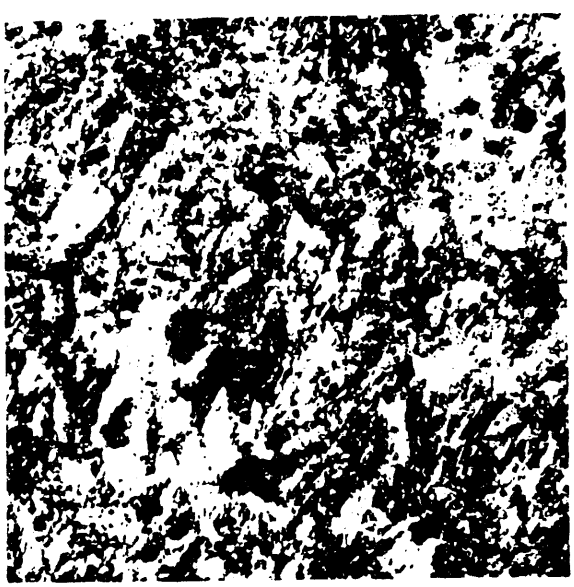

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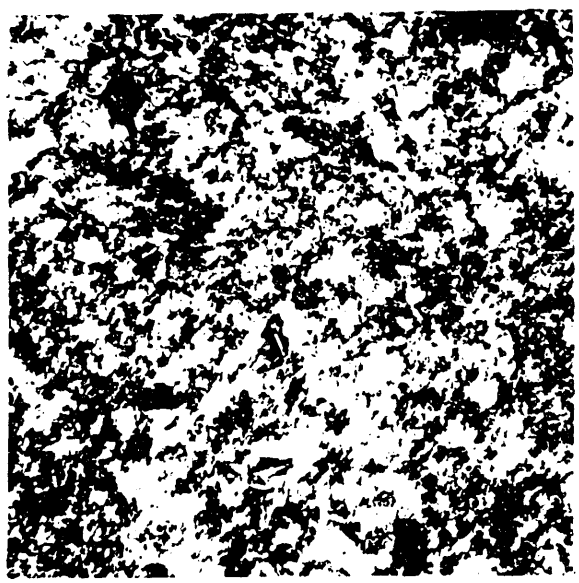

Nine Seconds

FIGURE 6

PHOTOMICROGRAPHS SHOWING TRANSFORMATION OF ALPHA PLUTONIUM AT 100 C. 200 X.

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